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constituent ^{as} with the ultrafine ceramic oxide powder in water or
an organic solvent; dispersing by mixing ^{with the ceramic sol solution} the suspension in which
the ultrafine ceramic oxide powder is dispersed ~~with the ceramic~~
~~sol solution~~; forming a piezoelectric/electrostrictive film
5 element by submerging a substrate into the suspension ⁱⁿ which the
ultrafine ceramic oxide powder and the ceramic sol solution are
mixed and then ~~by~~ performing electrophoretic deposition; and
thermally treating the piezoelectric/electrostrictive film
element at 100-600°C, so that the solvent is removed by the
thermal treatment and ~~the~~ bonding among the ultrafine ceramic
oxide powder particles is induced, while the ceramic sol acts as
a reaction medium on the surfaces of the ceramic oxide
particles. ✓

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow diagram ^{for} producing method ^{of} ultrafine
ceramic oxide powder used in the present invention. ✓

Figure 2 is a flow diagram of ^{forming} process ^{for forming} of
piezoelectric/electrostrictive film element using the
conventional electrophoretic deposition. ✓

20 Figure 3 is a flow diagram of a method for forming a
piezoelectric/electrostrictive film element using ~~the~~
electrophoretic deposition at low temperature according to the
present invention.

DETAIL DESCRIPTION

25 The present invention will be explained in detail.

First, a method for producing a ^{ultrafine} ceramic oxide
powder used as a raw material in ^a piezoelectric/electrostrictive
film element ^{producing} according to the present invention as in ✓

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a flow diagram of Figure 1 will be explained.

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A ^{manufacturing} ultrafine ceramic oxide powder producing method of the ✓
present invention comprises the steps of: sufficiently
dissolving or uniformly dispersing the raw material of
constituent ceramic elements in ^a solvent or dispersant to make a
5 solution or a dispersion mixture containing the constituent
ceramic elements; adding, into the solution or the dispersion
mixture containing the constituent ceramic elements, citric acid
in no less than the required amount to give rise to an
oxidative-reductive combustion reaction with an anion of the
ceramic constituent ceramic element so as to make a mixed
solution; and thermally treating the mixed liquid at 100-500°C.
But it may additionally further comprises a step of conducting
additional thermal treatment at 700-900°C to increase
crystallinity.

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As for the raw material containing the constituent ceramic
elements, use is made of ~~from among~~ ^{from among} oxide, carbonate, nitrate ✓
etc. of constituent ceramic element, its salt with organics or
inorganics, or ^a constituent ceramic element ~~complex~~ complex. ✓

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As for the constituent ceramic element, it is preferable to
use a piezoelectric/electrostrictive ceramic element comprising
lead (Pb) and titanium (Ti) as basic constituent elements.

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Especially as ^{to} for the constituent ceramic element, it is ✓
preferable to use that composed of elements including lead (Pb),
zirconium (Zr) and titanium (Ti), or lead (Pb), zirconium (Zr),
titanium (Ti) / lead (Pb), magnesium (Mg), niobium (Nb).

As for the solvent, or the dispersant to dissolve or
30 ^{to} disperse the raw material of constituent ceramic elements, one ✓
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or more are selected ~~to use~~ from among water and organic solvents that can dissolve or disperse the raw material containing the constituent ceramic elements. As for the organic solvents, mainly acetic acid, dimethyl formamide, methoxyethanol, alcohols, ^{or} glycols ~~etc.~~ are used.

As for the combustion aid, citric acid is used, which is an organic compound that can give rise to combustion reaction. In the conventional method, ~~the~~ citric acid has been used not as a combustion aid but ^{as} a complexing agent in order to give reaction uniformity, and ^{it} has been used in process ^{es} such as ^{the} Pechini process, where ^a speed-controlled combustion reaction can be induced using citric acid's flammability and complex formation effect.

A mixture is made by adding citric acid into a solution or a dispersed mixture where constituent ceramic elements are dissolved or dispersed. The quantity of the citric acid added shall not be less than the necessary amount to give rise to oxidative-reductive combustion reaction with the anion of the constituent ceramic element. Reaction speed can be controlled by the quantity of citric acid added.

The mixture made by the addition of the citric acid is thermally treated at 100-500°C. Though the crystallinity of the ceramic phase increases ^{with} the temperature for the thermal treatment, the citric acid combustion reaction may start enough if ^{the} only temperature for the thermal treatment is over 100°C. ~~And~~

Although ^{the} reaction can arise even if the temperature for the thermal treatment is above 500°C, thermally treating above that temperature is meaningless when comparing ^{ed} with the conventional method.